Ascophyllum nodosum: A Source of Exotic Invertebrates Introduced into West Coast Near-Shore Marine Waters

BY

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The introduction of marine mollusks into California waters has been discussed recently by Carlton (1969). He concerns himself with 2 possible methods of introduction of *Littorina littorea* Linnaeus, 1758 into San Francisco Bay:

1. with shipments of Atlantic oysters, *Crassostrea virginica* (Gmelin, 1791), planted in the Bay, or
2. with shipments of the Atlantic quahog, *Mercenaria mercenaria* (Linnaeus, 1758), either planted in the Bay or dumped into the Bay by shippers after spoilage.

Since both the oyster and the quahog are mud dwellers it is not unlikely that closely associated organisms would be carried along with them, particularly if the animals were shipped in or with substrate. This might easily explain the introduction of mud or sand dwellers such as *Nassarius obsoletus* (Say, 1882), *Gemma gemma* (Totten, 1834), *Busycotypus canaliculatus* (Linnaeus, 1758), or *Urosalpinx cinereus* (Say, 1882), a predatory associate of oysters. It would not account for the introduction of a rocky intertidal inhabitant like *Littorina,* however.

There is another method of organism introduction into San Francisco Bay, and probably many other bays on the West Coast, that is not only continually on the increase but is a source of dozens of exotic species of invertebrates and algae. The source is *Ascophyllum nodosum* (Linnaeus) Le Jolis, 1829 (and many members of the genus *Fucus*) used as packing material to protect the American lobster *Homarus americanus* Milne-Edwards, 1837 during air shipment from the northeastern United States. These fucoids characteristically bear a small population of invertebrates and algae, most of which are inhabitants of the upper to mid-intertidal. Since shipment is rapid, most of these forms survive and can be introduced into possibly suitable environments if the alga is dumped into local marine waters within several hours after arrival. I have obtained animals from these shipments which have been successfully maintained at marine stations and have sometimes used algae sent with lobsters as a source of experimental material when short of funds.

In 1966, I talked to a shipper near Fisherman's Wharf who supplies many of the restaurants in the Bay area and was told that it was his practice to dump the algae into the Bay. Since several shipments arrive per month and the demand for lobsters is unlikely to decrease, we can expect that an increasing number of potential seed organisms will be released into the Bay in the future. I have found the following organisms to be relatively common survivors in these shipments:

Coelenterata
- *Campanularia flexuosa* (Hincks, 1857)
- *Clava leptostyla* Agassiz, 1862
- *Sertularia pumila* Linnaeus, 1758

Platyhelminthes
- *Monoophorum* sp.
- *Monocoelis* sp.
- (several other unidentified Rhabdocoels and Alleocoels)

Annelida
- *Spirorbis* sp.

Crustacea
- *Ampelisca* sp.
- (several unidentified gammarid amphipods)

Mollusca
- *Littorina littorea* Linnaeus, 1758
- *Littorina obtusata* Linnaeus, 1758
- *Mytilus edulis* Linnaeus, 1758
- *Mitrella lunata* Say, 1882

Ectoprocta
- *Flustrellidra* sp.
- *Bowerbankia* sp.

Other species, less commonly found, are:

Porifera
- *Leucosolenia* sp.

Coelenterata
- *Tubularia* sp.
- *Obelia* sp.
- *Gonothyrea loveni* (Allman, 1859)

Annelida
- several species of small errant worms

Crustacea
- *Balanus amphitrite niveus* Darwin, 1854

Echinodermata
- *Asterias forbesi* (Desor, 1848)

Ectoprocta
- *Bugula* sp.

The numbers and species composition in any one shipment vary widely depending on the season of the year and presumably the area from which the algae were originally collected. The resistance of these organisms to

desiccation varies considerably with the species, and the overall prevalence of the forms listed above reflects this.

Some of the algae found include:

Chaetomorpha area KUTZING, 1845
Sphacelaria cirrosa AGARDH, 1824
Polysiphonia sp.
Ulva lactuca LINNAEUS, 1758
Ceramium sp.
Cladophora sp.
Enteromorpha sp.

Investigators should be aware that these organisms are being introduced now and have been introduced in the past in this manner. Since *Ascophyllum* floats, probably the entire Bay is subject to colonization by the organisms clinging to it. What is surprising is the lack of reports of these organisms. This could be ascribed to the resistance of the local fauna and flora to influxes of new forms (especially in the intertidal, where space competition is high), the presence of many of them as part of the already established fauna and flora, or simply the lack of systematic collecting in the Bay. It would seem worthwhile for someone to determine accurately the numbers and species composition of the viable organisms in *Ascophyllum* shipped with lobsters over a long period so that we know just what is entering the Bay by this route. Experiments designed to study the mode of distribution of these forms and their rates of survival in competition with the local fauna might be highly informative.

LITERATURE CITED

CARLTON, JAMES
1969. *Littorina littorea* in California (San Francisco and Trinidad Bays). The Veliger 11 (3) : 283 - 284 (1 Jan. 1969)

Cadlina modesta: A Range Extension, with Notes on Habitat and a Color Variation

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(1 Text figure)

IN THE ORIGINAL DESCRIPTION of *Cadlina modesta* MACFARLAND, 1966 (Nudibranchia : Dorididae), the species was recorded from Point Pinos and Point Cabrillo (Pacific Grove near Monterey, California, 36°36'N, 121°54'W) and from La Jolla, California (32°52'N, 117°15'W). Since then, its occurrence at intermediate points in the range has been established: SPHON & LANCE (1968), "frequent" occurrence in Santa Barbara County; and ROLLER & LONG (1969), "common" occurrence in San Luis Obispo County.

On April 8, 1969 (a −0.7 foot tide), I obtained 3 specimens that were crawling on the bottom of rocky tide pools in the middle to low intertidal zone (RICKETTS & CALVIN, 1968) at Moss Beach (37°31'N, 122°31'W), northern San Mateo County. This is an 85-mile northward extension of the range (measured along the coastline), and a new record for San Mateo County.

These specimens were kept alive in a one-gallon tank for about 36 hours. During this period I observed them crawling over some shoots of the alga *Gastroclonium coulteri* (HARVEY, 1853) at 7 different occasions. Three other species of nudibranchs [*Tritonia festiva* (STEARNS, 1873), *Diaulula sandiegensis* (COOPER, 1862) and *Cadlina luteomarginata* MACFARLAND, 1966] from Moss Beach were kept in another one-gallon tank, but I did not observe them in association with *G. coulteri* during this 36-hour period of random observation. *Gastroclonium coulteri* was placed in the tank because of its frequency along the sides of the pools where *C. modesta* was obtained.

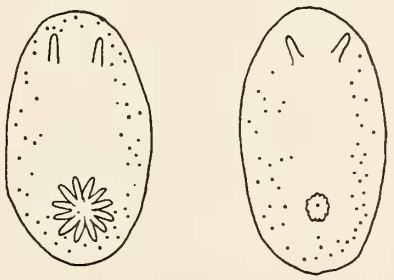

Figure 1

Sketch of *Cadlina modesta* MACFARLAND, 1966
A: Specimen with complete series of lemon-yellow spots
B: Specimen without spots in front of rhinophores (gills drawn retracted)

On April 19, 1969, I was again collecting at Moss Beach (a −0.5 foot tide), and found 2 additional specimens of *Cadlina modesta* in similar tide pool habitats. These were crawling over the calcareous coralline alga *Corallina* sp. when collected. Since MACFARLAND rather broadly described the habitat of these animals as "rocky open pools"